

## TWO COMMON SPECIES OF PARASITIC CRUSTACEA (SACCULINIDAE) OF THE WEST INDIES

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The chief characteristics defining the genera of the Rhizocephala concern the shape and the situation of the internal organs. One of the most important is the manner in which the visceral mass is attached to the mantle by a mesentery, which may be thin, as in *Sacculina* and allied genera, or thicker, as in *Peltogaster* and other parasites of the group. Smith (1906), the author of a monograph on the Rhizocephala, based the taxonomy of the group for a large part on the differences in the size and the place of the mesentery. This author created the new generic name *Heterosaccus*, the type species of which is *Sacculina hians* Kossmann, which is characterized by a very short mesentery. In this species it is confined to the immediate vicinity of the stalk only. According to Smith the internal structure of the other parasites of the group which live on crabs does not show any morphological differences, and consequently he united them under the name *Sacculina carcini*. In this respect, however, Smith's conclusions are wrong, for there are a number of species which can be distinguished from *S. carcini* by constant morphological features.

The mesentery of *Sacculina carcini* is complete; it stretches from the stalk to the mantle opening. In some other parasites, which have been described as species of the genus *Sacculina*, the mesentery is incomplete, for it terminates at some distance from the mantle opening. For these species of Sacculinidae with incomplete mesentery, in a recent paper (Boschma, 1927) I have founded the new genus *Drepanorchis*, the type species of which is *D. neglecta* (*Sacculina neglecta* Fraisse). Another constant feature of all the species belonging to this genus is found in the shape of the testes; they are curved, whereas in *Sacculina* they consist of more or less straight tubes.

There are a few species of Sacculinidae which in some respects constitute intermediate forms between the genera *Sacculina* and

*Drepanorchis*. In these species the mesentery is complete, as in *Sacculina*; the testes, however, have a curved shape, as in *Drepanorchis*. They differ from *Sacculina* as well as from *Drepanorchis* in another anatomical respect: The visceral mass is not (as in these two genera) connected with the stalk, but it is attached to the mantle at some distance from the stalk. I unite here the species which show the above-mentioned characteristics under the new generic name *Loxothylacus*. Accordingly, I consider the family Sacculinidae composed of four genera with the following chief characteristics:

*Sacculina*: Mesentery complete, testes straight, visceral mass united with the stalk.

*Loxothylacus*: Mesentery complete, testes curved, visceral mass united with the mantle at some distance from the stalk.

*Drepanorchis*: Mesentery incomplete, testes curved, visceral mass united with the stalk.

*Heterosaccus*: Mesentery almost wanting (confined to the immediate vicinity of the stalk).

There are a great number of species belonging to the Sacculinidae, although this number is smaller than Giard (1887, 1888) assumed, who upheld that every species of crab had its own species of rhizocephalous parasite. This theory (the theory of the absolute specificity of the parasites) has been combated by Smith (1906), who, however, went to the other extreme and expressed as his opinion that all the parasites of the genus *Sacculina* belong to one and the same valid species, *S. carcini* Thompson. Smith based this conclusion on the fact that he found no morphological differences between the parasites on different crabs in the material at his disposal. Now, this conclusion also was too far-reaching, for Giard (1887) had proved already that the parasite called by him *Sacculina fraissei* (= *Drepanorchis neglecta* (Fraisse), see Boschma, 1927) differs from *S. carcini* in constant morphological characteristics, the form and situation of the testes in both species being very different. Moreover, Kossmann (1872) had described morphological differences between species of Sacculinidae which were found on different hosts. His diagnoses of new species were based mainly on the structure of the chitinous covering of the mantle, which in many cases bears definitely shaped small excrescences. Kossmann also was convinced that a certain species of *Sacculina* could live on one species of host only and accordingly described too many forms as new species. The discovery of the appendages of the cuticle, however, was a valuable progress in the study of the Sacculinidae as it furnishes reliable data for the taxonomy of the group. Especially in tropical species (Kossmann's material had been collected at the Philippine Islands) these small projecting parts of the external cuticle are distinctly visible. In the same way in the collection of the Siboga

Expedition from the East Indian Archipelago also, the greater part of the Sacculinidae are sufficiently characterized by the peculiar structure of the excrescences on the external cuticle of the mantle (Van Kampen and Boschma, 1925). In the paper cited we were able to prove that a number of morphologically well defined species of *Sacculina* occur in the East Indies. Two more striking facts were observed, first, that a single species may occur as a parasite of several species of crabs, and, second, that certain species of crabs may be infested with two or more different species of *Sacculina*. Consequently this paper proves conclusively that the opinions of Giard as well as Smith can not be upheld.

A comparative study of a great number of European representatives of the genus *Sacculina* (Boschma, 1927) yielded almost the same results: Among the European forms one species of parasite may infest different species of crabs, as in the case of *Sacculina carcini*. In this region, however, two morphologically different species have never been found as parasites on one species of host. Previously Guérin-Ganivet (1911) published a paper in which notes were given on the anatomy of many European Sacculinids, and this author has already pointed out that a great number of the so-called species of Giard's have no real systematic value. According to Guérin-Ganivet we may regard a certain form as a definite species only in those cases in which morphological differences from other species can be demonstrated. In the paper cited I based my conclusions on the same premises.

In some cases a certain parasite infests exclusively crabs belonging to a small systematic group, as *Drepanorchis neglecta* (Fraisse), which is known to occur on the species of the genera *Macropodia* and *Inachus*. Both of these genera belong to the subfamily Inachinae (family Majidae) and the parasite, which is structurally very different from all other known European Sacculinids, is the only species of the group which is known to infest these crabs. The parasite of *Dorynchus thomsoni*, another species of the same subfamily, belongs to quite a different species (*Sacculina atlantica*), which is not found on any other crab. Another well defined species, *Sacculina eriphiae*, also seems to occur on one species of crab only, namely, *Eriphia spinifrons*. On the other hand *Sacculina carcini* infests a large number of hosts belonging to different families of Brachyura.

The West Indian species of Sacculinidae are very imperfectly known. One species has been described as *Sacculina panopaei* by Gissler (1884) after its host *Panopeus herbstii* (Milne-Edwards). The external form of this parasite is known, for the description is accompanied by two text-figures; its internal anatomy and the structure of its cuticle have not been described in the cited paper. Fortunately



my material includes a number of specimens which undoubtedly belong to the same species and a diagnosis of this species is found in the following pages. The study of its anatomy proves that it belongs to the genus *Loxothylacus*.

In the West Indian region, however, more than one species of Sacculinidae occur. Besides that described by Gissler, this family is represented by many other species, as I demonstrated a few years ago when I examined the material collected by Dr. Van der Horst at Curaçao (Boschma, 1925). Three specimens of *Sacculina* were represented in this collection, each of which constituted the type specimen of a new species.

Although there are a great number of West Indian species of Sacculinidae, only two seem to occur as common forms. One of these is Gissler's species, the other, which is described in the present paper under the name *Drepanorchis occidentalis*, has not been recorded before. It is an interesting fact that each of these species is found on several species of crabs, but each infests a definite group of systematically related hosts. *Drepanorchis occidentalis* lives on crabs of the family Majidae, whereas *Loxothylacus panopaei* is known as a parasite of *Panopeus* and nearly allied genera, all of which are representatives of the family Xanthidae. Consequently just as in European species the Sacculinidae of the West Indian region are restricted to definite families of crabs within which these two common parasites infest several different species.

The descriptions of the two species that follow are entirely based on the material of the United States National Museum, in which both are represented by a number of specimens.

#### DREPANORCHIS OCCIDENTALIS, new species

*Type*.—Cat. No. 60608, U.S.N.M., on *Mithrax forceps* (A. M.-E.), "Fish Hawk" Sta. 7153. Deadman's Bay, west coast of Florida.

The shape of the animals is roundish or somewhat irregular, often with more or less well-marked angular tips. (Fig. 1.) The size is variable, some specimens have a greater diameter of 4 mm. or less, whilst others are much larger. The largest specimen in the collection (fig. 1*c*, *d*) measures 11.5 mm. from the dorsal to the ventral surface (the diameter at right angles with the axis through the mantle opening and the stalk). As in other species of Sacculinidae the size of the parasites depends at least partially on the size of their hosts: The larger specimens are found on crabs belonging to species which may attain a comparatively large size.

The mantle opening, which lies approximately opposite the stalk, is rather wide. It is often surrounded by a wall-shaped projection of the mantle, which may form a tubelike expansion.

The internal anatomy of the species resembles strongly that of the type species of the genus, *Drepanorchis neglecta* (see Boschma, 1927). The closed end of the testes in *D. occidentalis* is found in the posterior part of the visceral mass (nearer to the stalk than to the mantle opening); in *D. neglecta* this part of the testes is situated at a comparatively greater distance from the stalk. The testes of *D. occidentalis* have a fairly large size. (Fig. 2.)

The colleteric glands occupy about the center of the lateral surfaces (in *D. neglecta* these organs are much nearer to the mantle opening). The colleteric glands contain a comparatively small number of branched tubes.

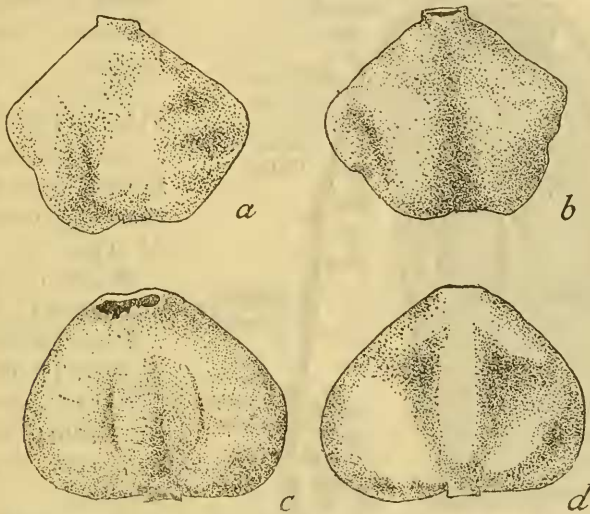


FIG. 1.—TWO SPECIMENS OF *DREPANORCHIS OCCIDENTALIS*. *a*, FROM MITHRAX FORCEPS (A. MILNE-EDWARDS), THE SURFACE LYING AGAINST THE THORAX OF THE HOST,  $\times 3\frac{1}{4}$ . *b*, THE SAME SPECIMEN, THE SURFACE LYING AGAINST THE ABDOMEN OF THE HOST,  $\times 3\frac{1}{4}$ . *c*, FROM MACROCOELOMA CAMPTOCERUM (STIMPSON), THE SURFACE LYING AGAINST THE THORAX OF THE HOST,  $\times 3$ . *d*, THE SAME SPECIMEN, THE SURFACE LYING AGAINST THE ABDOMEN OF THE HOST,  $\times 3$ . IN THESE FIGURES THE MANTLE OPENING IS FOUND IN THE UPPER PART, THE STALK IN THE LOWER PART

The typical characteristics of *D. occidentalis* are those of the external and internal cuticle of the mantle. The external cuticle is a thin layer of chitin; its thickness does not exceed  $10\mu$ . It has a smooth surface without any excrescences. Seen from above the surface is divided into small areas which have a diameter of 10 to  $15\mu$  and are surrounded by more or less meandering lines. (Fig. 3 *a, b*.)

On the internal cuticle of the mantle a great number of retinacula are found, more than in any other species of Sacculinid. (Fig. 3, *c-h*.) The internal cuticle is divided into small areas of approximately  $100\mu$  diameter; in detached pieces of this cuticle the marginal parts of these areas are more or less wrinkled. Each of these small

areas bears one or two retinacula. (Fig. 3*d*.) The retinacula are about  $30\mu$  long; their broadened basal part is surrounded by a circular groove at the place where they are attached to the cuticle. The apical part of the retinacula bears 5 to 10 spindle-shaped excrescences of about  $15\mu$  length, which are provided with small lateral barbs. (Fig. 3 *c-h*.)

In the material of the United States National Museum *Drepanor-  
chis occidentalis* occurs on the following hosts:

*Macrocoeloma camptocerum* (Stimpson); of Florida.

*Macrocoeloma diplacanthum* (Stimpson); Cuba.

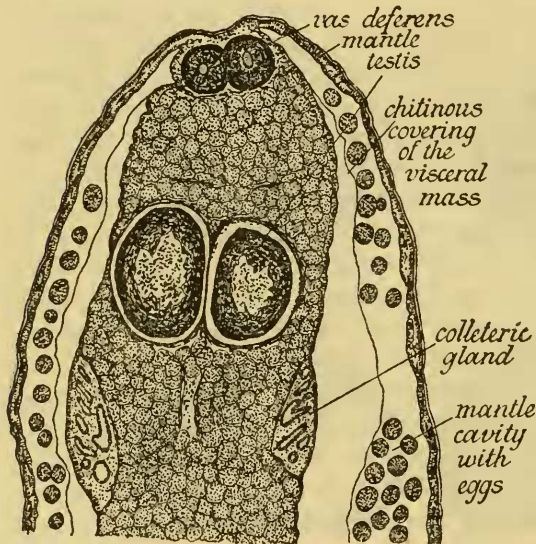


FIG. 2.—DREPANORCHIS OCCIDENTALIS FROM MITHRAX  
FORCEPS (A. MILNE-EDWARDS), LONGITUDINAL SECTION,  
× 30

*Microphrys bicor-  
nutus* (Latreille); off  
Florida; Cuba; Ba-  
hamas.

*Mithrax forceps*  
(Herbst); Bahamas.

*Mithrax forceps* (A.  
Milne-Edwards); west  
coast of Florida. (Host  
of type.)

*Mithrax sculptus*  
(Lamarck); Jamaica.

*Pitho anisodon* (von  
Martens); off Florida.

*Pitho lherminieri*  
Schramm; Key West  
or west coast of  
Florida.

*Stenocionops furcata*  
*coelata* (Milne-Ed-  
wards); off Florida.

Among these crabs the species of the genera *Macrocoeloma*, *Microphrys*, and *Mithrax* belong to the family Periceridæ, and the family Majidæ is represented by the genera *Pitho* and *Stenocionops*.

#### LOXOTHYLACUS, new genus

Body laterally compressed, mantle opening opposite the stalk. Visceral mass attached to the mantle at some distance from the stalk. Mesentery thin, extending from the place where the visceral mass is united with the mantle to the mantle opening. Colleteric glands with a number of branched tubes, in or near the central part of the lateral surfaces of the visceral mass. Testes curved, the convex part running along the mesentery.



The type species of this genus is *Sacculina corculum* Kossmann. Among my material I have complete series of sections of three specimens belonging to this species. All of these have a complete mesentery and curved testes, whilst the visceral mass is united with the mantle at some distance from the stalk.<sup>1</sup> Kossmann's figure of the type species does not show distinctly the unusual place of the stalk.<sup>2</sup> The other characteristics of the genus (the curved testes and the complete mesentery) are clearly drawn in another figure by the

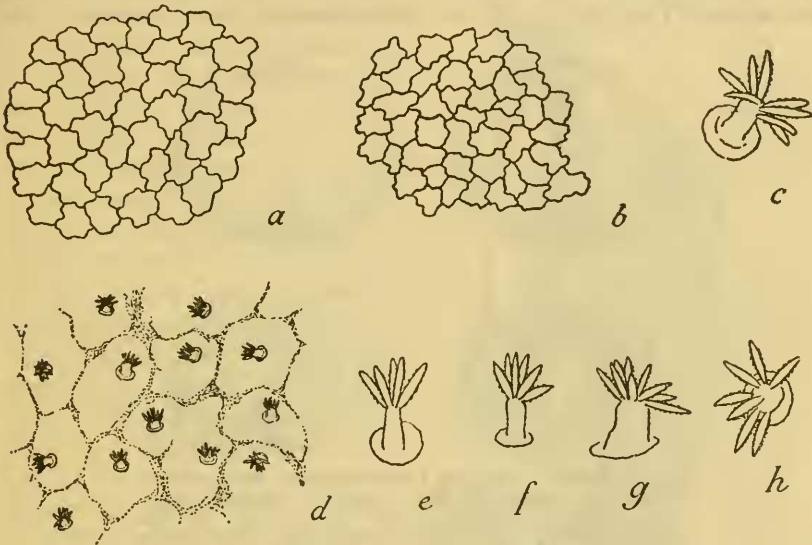


FIG. 3.—DREFPANORCHIS OCCIDENTALIS. *a*, PART OF THE EXTERNAL CUTICLE OF A SPECIMEN FROM PITHO ANISODON (VON MARTENS),  $\times 440$ . *b*, PART OF THE EXTERNAL CUTICLE OF A SPECIMEN FROM MITHRAX FORCEPS (A. MILNE-EDWARDS),  $\times 440$ . *c*, RETINACULUM OF A SPECIMEN FROM MACROCOELOMA CAMPTOCERUM (STIMPSON),  $\times 440$ . *d*, INTERNAL CUTICLE WITH RETINACULA OF A SPECIMEN FROM MICROPHRYS BICORNUTUS (LATREILLE),  $\times 110$ . *e*, RETINACULUM OF A SPECIMEN FROM MITHRAX SCULPTUS LAMARCK,  $\times 440$ . *f*, RETINACULUM OF A SPECIMEN FROM PITHO ANISODON (VON MARTENS),  $\times 440$ . *g* AND *h*, RETINACULA OF A SPECIMEN FROM MICROPHRYS BICORNUTUS (LATREILLE),  $\times 440$

same author.<sup>3</sup> Probably the first of Kossmann's above cited figures was not altogether correct, for all other peculiarities of my specimens closely fit in with this author's description. As in the type specimen their external cuticle is provided with long and stout spines. On account of the last-named feature the species *Loxothylacus corculum* (Kossmann), is one of the best characterized species of the whole family. The West Indian species which is described below differs from *L. corculum* especially in the smaller size of its cuticular excrescences.

<sup>1</sup> See Van Kampen and Boschma, 1925, pl. 2, fig. 3.

<sup>2</sup> See Kossmann, 1872, pl. 2, fig. 5b.

<sup>3</sup> Idem. pl. 2, fig. 5a.

## LOXOTHYLACUS PANOPAEI (Gissler)

*Sacculina panopaei* GISSLER, 1884

The animal has a roundish shape; in some cases the mantle has more or less distinctly marked tips. (Fig. 4.) The size is variable, though in general the parasites of this species are small; the largest specimen in the collection has a greater diameter of about 6 mm.

The mantle opening lies at the top of a small tube-like expansion of the mantle, which is usually directed towards the surface which lies against the thorax of the host. In the type specimen (see

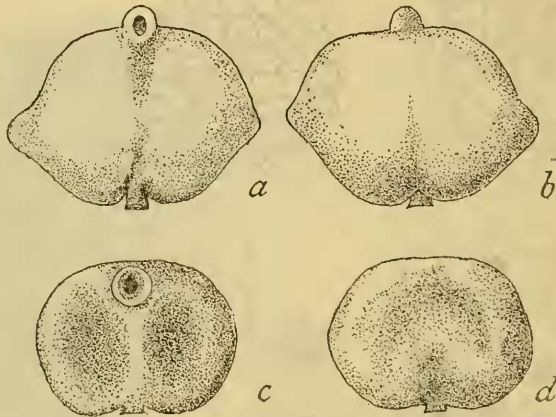


FIG. 4.—TWO SPECIMENS OF *LOXOTHYLACUS PANOPAEI* (GISSLER). *a*, FROM *PANOPEUS HERBSTII* MILNE-EDWARDS, THE SURFACE LYING AGAINST THE THORAX OF THE HOST,  $\times 7\frac{1}{2}$ . *b*, THE SAME SPECIMEN, THE SURFACE LYING AGAINST THE ABDOMEN OF THE HOST,  $\times 7\frac{1}{2}$ . *c*, FROM *EURYPANOPEUS DEPRESSUS* (SMITH), THE SURFACE LYING AGAINST THE THORAX OF THE HOST,  $\times 7\frac{1}{2}$ . *d*, THE SAME SPECIMEN, THE SURFACE LYING AGAINST THE ABDOMEN OF THE HOST,  $\times 7\frac{1}{2}$ . IN THESE FIGURES THE MANTLE OPENING IS FOUND IN THE UPPER PART, THE STALK IN THE LOWER PART

Gissler, 1884, figs. 1 and 2) this tubular expansion of the mantle also is well developed.

In the accompanying figure (fig. 5), a longitudinal section parallel to the dorsal and the ventral surfaces, all the characteristics of the genus *Loxothylacus* are visible: The stalk is attached to the mantle at some distance from the visceral mass, a section of the closed part of one of the testes is found in the posterior part of the visceral mass, and in the lower part of the figure (consequently in the anterior part of the animal) the visceral mass is attached to the mantle by the mesentery. The section is from the immediate vicinity of the mantle opening, a part of the sphincter which surrounds the mantle opening is visible in the lower part of the figure.



The testes are strongly curved, their extremity lies at a short distance from the vasa deferentia (in *L. corculum* the closed end of the testes lies much nearer to the mantle opening). The colleteric glands occupy about the central part of the lateral surfaces; they contain a large number of tubes.

The external cuticle of the mantle is rather thin, 8–12 $\mu$  approximately. Its upper surface consists of small areas which have an irregular contour; the diameter of these areas is about 9–12 $\mu$ . In some of the specimens of the material each of the cuticular areas bears a small spine (fig. 6*b*); in other specimens a much smaller number of these spines occurs, as only about one-fourth of the total number of areas has such an excrescence (fig. 6*a*). These spines are tapering from the base to the top, which is evenly rounded; they may attain a length of 20 $\mu$  and a thickness (at the base) of 3 $\mu$ . In different parts of the mantle of one specimen of *L. panopaei* the spines may be of different sizes. (See fig. 6*c*, *d*.) On the whole the differences between the cuticular excrescences of different specimens (even those which live on different hosts) are not more striking than those found among the spines of different parts of the mantle of one specimen.

The internal cuticle of the mantle bears small retinacula (fig. 6, *g-i*) which consist of a very insignificant basal part and a number (3 to 5) of spindle-shaped excrescences of 6–9 $\mu$  length. Lateral barbs could not be detected on these spindles.

The material of the United States National Museum contains specimens of *Loxothylacus panopaei* on the following hosts:

*Panopeus occidentalis* (Saussure); Porto Rico.

*Eurypanopeus depressus* (Smith); Florida (?); Texas.

*Panopeus herbstii* Milne-Edwards; Jamaica; Cuba.

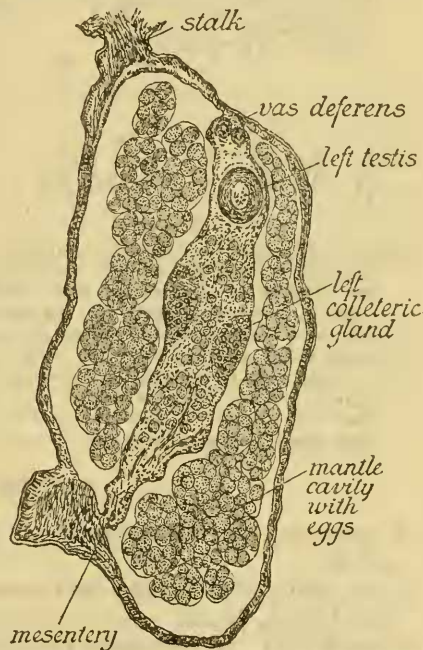


FIG. 5.—*LOXOTHYLACUS PANOPAEI* (GISSLER)  
FROM *EURYPANOPEUS DEPRESSUS* (SMITH).  
LONGITUDINAL SECTION,  $\times 30$

Gissler's specimen on which the original description of the species was based was a parasite of *Panopeus herbstii*, collected on the coast of Florida (Tampa).

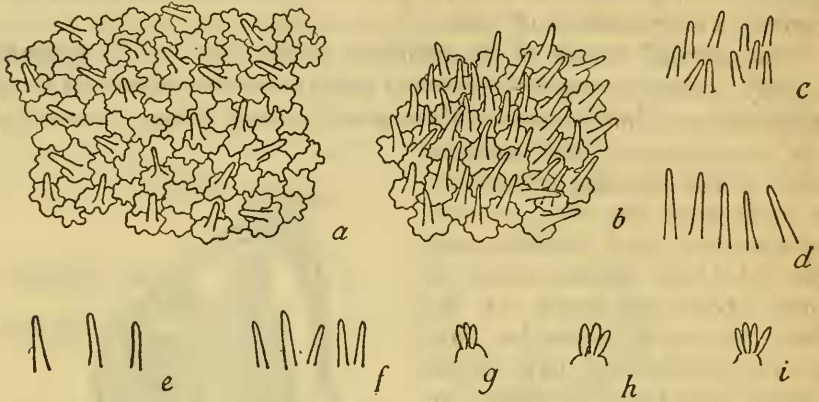


FIG. 6.—*LOXOTHYLACUS PANOPÆI* (GISSLER). *a*, PART OF THE EXTERNAL CUTICLE OF A SPECIMEN FROM *EURYPANOPEUS DEPRESSUS* (SMITH),  $\times 440$ . *b*, PART OF THE EXTERNAL CUTICLE OF A SPECIMEN FROM *PANOPEUS HERBSTII* MILNE-EDWARDS,  $\times 440$ . *c* AND *d*, APPENDAGES FROM TWO DIFFERENT PLACES ON THE EXTERNAL CUTICLE OF A SPECIMEN FROM *PANOPEUS HERBSTII* MILNE-EDWARDS,  $\times 440$ . *e*, CUTICULAR APPENDAGES OF ANOTHER SPECIMEN FROM *PANOPEUS HERBSTII* MILNE-EDWARDS,  $\times 440$ . *f*, CUTICULAR APPENDAGES OF A SPECIMEN FROM *PANOPEUS OCCIDENTALIS* (SAUSURE),  $\times 440$ . *g*, RETINACULUM OF A SPECIMEN FROM *EURYPANOPEUS DEPRESSUS* (SMITH),  $\times 440$ . *h*, AND *i*, RETINACULA OF TWO DIFFERENT SPECIMENS FROM *PANOPEUS HERBSTII* MILNE-EDWARDS,  $\times 440$ .

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